

California High-Speed Train Program EIR/EIS

DRAFT **Revisions to Mountain Crossing Recommendations**

Prepared by:

[California High-Speed Rail Authority](#)

January 18, 2002

First Screening Report—Part 1

Revisions to Mountain Crossing Recommendations

(San Jose-to-Merced and Bakersfield-to-Sylmar segments)

At the September Authority meeting in Los Angeles, staff presented mountain crossing recommendations for the San Jose-Merced and Bakersfield-Sylmar segments. Due to the complexities of the mountain crossings, staff recommended that additional work was needed to better identify and refine the alternative mountain crossing routes. A tunneling conference summit was arranged to receive technical and practical input regarding all aspects of tunnel design and construction. The leading national and international experts participated and provided valuable information that was used in further refinement of the options.

Recognizing the limitations on alternative analysis through conventional means, staff engaged the Quantm systems state of the art methodology to evaluate millions of alignments through the mountains. This allowed the staff to verify the viability of alignments evaluated and to optimize the location of those alignments particularly with respect to tunnel and bridge costs and earthwork.

The revised recommendations for the San Jose-to-Merced and the Bakersfield-to-Sylmar segments incorporate the tunneling length and fault crossing assumptions derived from the Tunneling Summit. This workshop confirmed the objective of minimizing the amount of tunneling required, due to cost, time of construction and potential for delay, and the desirability of crossing of major fault zones at grade. It also confirmed the assumption that the unit cost for tunneling would increase dramatically for tunnels exceeding six-miles in length. With the updated tunneling assumptions, staff was able to develop optimal alignments using the Quantm system.

As a result of additional information obtained from the tunneling summit and alignment optimization, staff recommendations for the mountain crossings have been revised. The following is a summary of the revised alignment and station options that are being recommended for further evaluation in the San Jose-to-Merced segment of the Bay Area-to-Merced Corridor and Bakersfield-to-Sylmar segment of the Los Angeles-to-Bakersfield Corridor. The screening report serves to document the significant reasons for removing certain alternatives from further consideration. All of the "First Screening Report" recommendations were developed with input from both the Federal Railroad Administration and the Authority's legal counsel.

The objective of the first screening report is to eliminate those options that due to significant environmental, operational or technical reasons are not suitable for high-speed rail. There are at least two viable options for the entire system, except in those few instances where clear and documented data was available to limit the options to a single alignment.

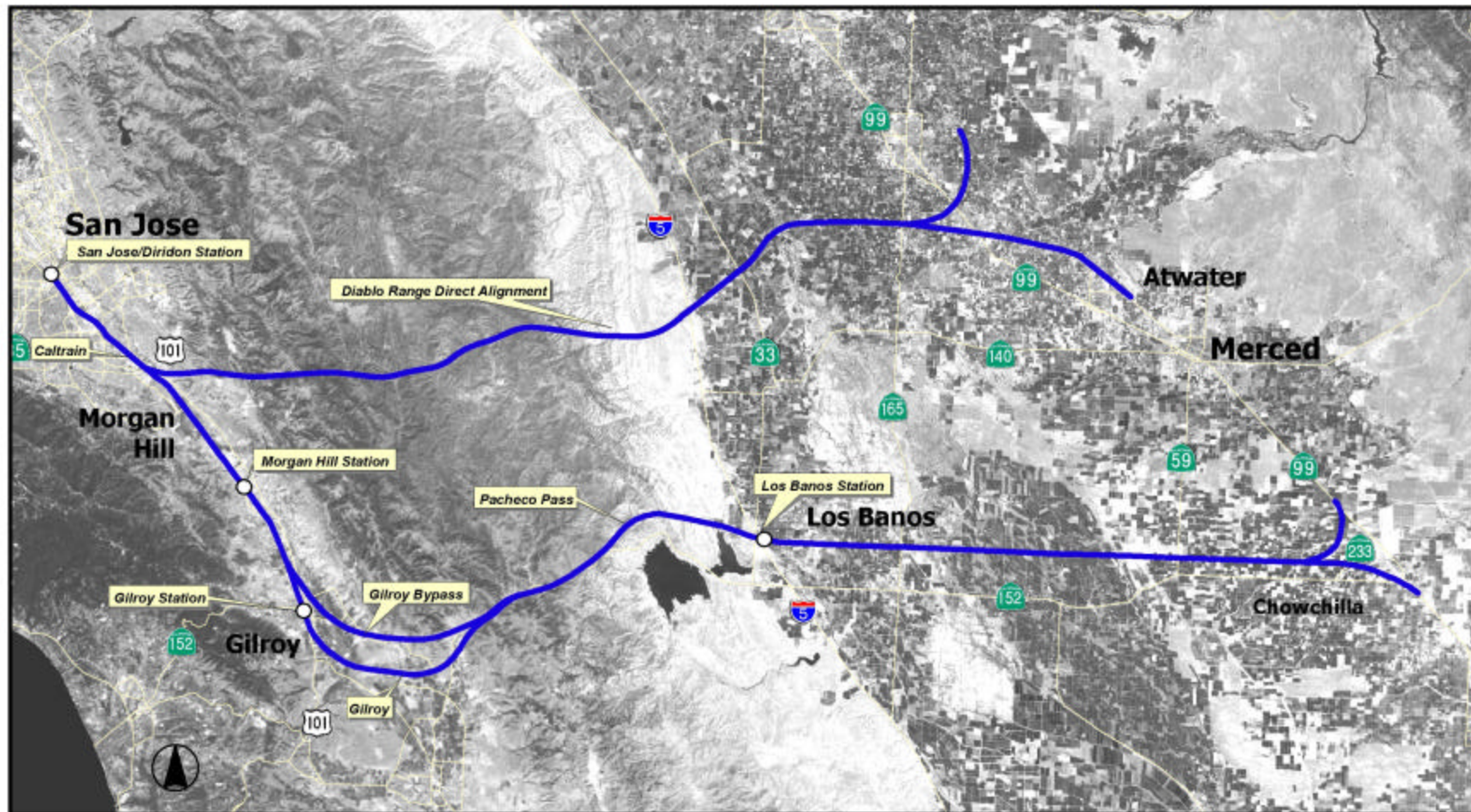
San Jose-to-Merced

Alignment and Station Location Options for Further Evaluation

Based on information obtained through the initial evaluation, the following alignment and station location is recommended for further evaluation (see Figure 1):

Alignments:

- **Diablo Range Direct Alignment (3.5% Maximum Grade):** This alignment would have a station at the existing San Jose (Diridon) Station heading south on the Caltrain/UPRR, just north of I-85



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Legend

- Alignments to be Evaluated
- Station Locations to be Evaluated

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**Alignment and Station Locations to be Evaluated
Merced to San Jose Segment**

Figure 1

- turning east through the Diablo Range to San Joaquin Valley to Merced using the northern alignment (near Castle Air Force Base).

This Diablo Range Direct Alignment (about 92 miles long) would be shorter in length than the Pacheco Pass Alignment options by 24 miles, and would offer far superior travel times from Sacramento to the Bay Area as compared to Pacheco Pass options. It would be approximately 28 minutes faster from Sacramento to San Jose than the Caltrain/Gilroy/Pacheco Pass Alignment for express (nonstop) services, with a difference of 35 minutes for local trains. For local trains traveling from San Jose to Los Angeles, the Diablo Range Direct Alignment would save 11 minutes compared to the Gilroy/Pacheco Pass Alignment that has local stops in Gilroy and Los Banos (express service travel times would be about the same). Operational cost savings would occur for this service, given that the amount of alignment traveled for the Diablo Range Direct Alternative would be approximately 64-miles shorter than the Gilroy/Pacheco Pass Alignment for service between Sacramento and San Jose. In addition, the Diablo Range Direct Alignment option would place the Merced Area on the Los Angeles-to-Bay Area line, with more frequent train services compared to the Sacramento-to-Bay Area line. For these reasons, this Diablo Range Direct Alternative is expected to have the highest ridership and revenue potential and to maximize connectivity and accessibility.

The Diablo Range Direct Alignment would have about 11 total miles of tunneling required, with no continuous tunnel exceeding 5-miles in length. The alignment would cross three active and potentially active faults at-grade including the Ortigalita Fault, the southern extension of the Greenville Fault trend, and the Calaveras Fault zone. The most negative aspects of this alignment are that it bisects a portion of the Henry W. Coe State Park and it is located several miles south of the nearest access road (SR-130). If these constraints cannot be adequately mitigated, a variation of this alignment has been identified that bypasses the Henry W. Coe State Park to the north, and has good access to SR-130, however, it has about 16.5-miles of total tunneling (with no single tunnel exceeding 5.5 miles in length).

- **Caltrain/Gilroy/Pacheco Pass Alignment (3.5% Maximum Grade):** This alignment would extend south along the Caltrain/UPRR rail corridor through the Pacheco Pass and then the San Joaquin Valley to Merced. Station options include the existing San Jose (Diridon) Station, Gilroy (near the existing Caltrain Station), and Los Banos (near I-5) in the San Joaquin Valley.

The Pacheco Pass alternatives would minimize the amount of tunneling required between San Jose and Merced. Tunneling through this pass could be reduced to a total as little as about 5-miles. This Pacheco Pass Alignment would provide potential high-speed train service to the Morgan Hill or Gilroy and the Los Banos areas. In addition to serving the City of Gilroy, this alignment would best serve the Salinas/Monterey Bay populations. This alignment would have the most impacts on natural resources and social and economic resources, but would maximize avoidance of areas with erodible soils and steep slopes as compared with the other Pacheco Pass alternatives.

- **Morgan Hill/Caltrain/Pacheco Pass Alignment (3.5% Maximum Grade):** This alignment would extend south along the Caltrain/UPRR rail corridor through the Pacheco Pass and San Joaquin Valley to Merced. Station options include the existing San Jose (Diridon) Station, Morgan Hill (near the existing Caltrain Station), and Los Banos (near I-5) in the San Joaquin Valley.

This alignment would be shorter than the Gilroy alignment by three to four miles, and would reduce impacts to water resources, farmlands, and floodplains as compared to the Gilroy/Caltrain/Pacheco Pass alternative but would have additional erodible soils, and steep slope constraints. Travel times and costs would be slightly improved with this option, but there would be a reduction in connectivity and accessibility to the region as a whole since Gilroy could not be served directly. Since there is no existing transportation corridor linking the Pacheco Pass to Morgan Hill via the Pacheco Pass, additional study is

needed to refine this portion of the route to optimize its feasibility and minimize its community and environmental impacts.

Station Locations:

- **San Jose (Diridon) Station:** This potential station would serve all alignment options (Caltrain/Monterey Highway rights-of-way) into San Jose.
- **Morgan Hill (Caltrain) Station:** This potential station would serve the Pacheco Pass/Gilroy/Caltrain and Pacheco Pass/Caltrain/Morgan Hill alignment options.
- **Gilroy Station:** This potential station would serve the Pacheco Pass/Gilroy/Caltrain option.
- **Los Banos Station:** This potential station would serve the Pacheco Pass/Gilroy/Caltrain and Pacheco Pass/Caltrain/Morgan Hill alignment options.

1.3.2 Alignment and Station Location Options to be Eliminated (No Further Evaluation)

Based on information obtained through the initial evaluation, the following alignment and station location options are recommended to be eliminated from further evaluation (see Figure 2):

Alignments:

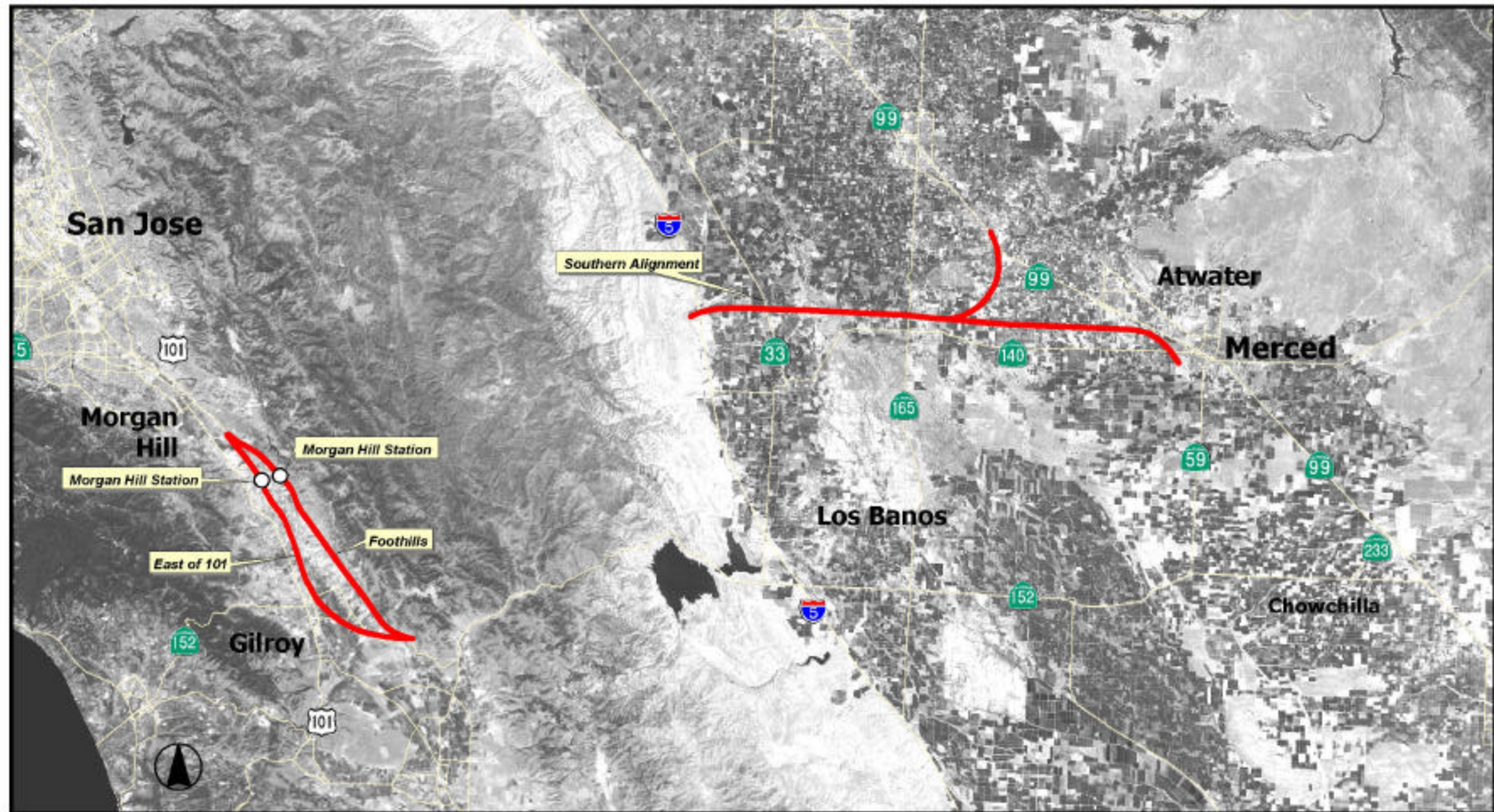
- **Southern Alignment (Central Valley portion of San Jose-Merced Segment):** This alignment would extend from the eastern base of the Diablo Range through the San Joaquin Valley to Merced (at a Merced Municipal Airport Station).

The Southern Alignment should be eliminated from further investigation since the northern alignment through the Central Valley is a superior alternative. A northern alignment provides for faster travel times between Sacramento and San Jose, and enables all potential Merced station locations to be served on the Los Angeles-to-Bay Area train line (rather than the Sacramento-to-Bay Area line), providing more frequent service to Merced. For the Southern Alignment, only the southern Merced station locations (excluding Castle Air Force Base and U.C. Merced) could be served on the Los Angeles-to-Bay Area line.

The Southern Alignment would pass through the San Luis National Wildlife Refuge, which is characterized by major wetland areas, while the northern alignment would pass to the north of this Refuge. The Southern Alignment passes through a greater length of wetlands – approximately 4.4 miles (7 km), including the San Luis Wildlife Refuge, compared to the northern alignment that would pass through an estimated 2.4 miles (3.8 km) of wetland areas and passes beyond the limits of the Wildlife Refuge. The Southern Alignment would also pass through a higher length of floodplain, more farmlands of statewide importance, and more sensitive habitats as compared to the northern alignment.

- **Direct Tunnel Alignment:** This alignment would have a station at the existing San Jose (Diridon) Station heading south on the Caltrain/UPRR, just north of I-85 turning east into a long (31-mile-49.6 km) tunnel to San Joaquin Valley to Merced (near Castle Air Force Base).

The Direct Tunnel Alignment would cross three active and potentially active faults in tunnel including the Ortagalita Fault, the southern extension of the Greenville Fault trend, and the Calaveras Fault zone. The Direct Tunnel Alignment is likely to cost at least \$2 billion more than the Diablo Range Direct Alignment that utilizes a 3.5% gradient to minimize tunneling. This higher cost is due largely to the long tunnel and the high unit cost per-mile associated with tunnels that exceed 6-miles in length. The Direct Tunnel concept would involve construction of a tunnel that would be among the longest in the world



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Legend

- Alignments to be Eliminated
- Station Locations to be Eliminated

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**Alignment and Station Locations to be Eliminated
Merced to San Jose Segment**
Figure 2

(31 miles/49.6 km) though difficult mixed soil and geology types. The results of the Tunneling Summit concluded that in California, a tunnel of this length, while not infeasible, is prohibitive from a construction, operation and cost perspective.

- **Caltrain/Morgan Hill/Foothill/Pacheco Pass Alignment:** This alignment would extend south along the Caltrain/UPRR rail corridor, traveling south in the foothills east of U.S. 101 through the Pacheco Pass and the San Joaquin Valley to Merced.

The Caltrain/Morgan Hill/Foothill/Pacheco Pass Alignment is the least costly of all alignments in this segment, primarily due to less tunneling and its shorter length compared to the other Pacheco Pass alignments. However, this alignment would have the most impacts to sensitive habitat (through the foothills), and would have high visual impacts. This new transportation corridor through the foothills would be the least compatible with existing and planned development, yielding severe impacts on the existing suburban, rural and open space areas in the foothills, and would provide minimal connectivity and accessibility. It would not link to the Caltrain commuter rail service south of San Jose.

- **Caltrain/Morgan Hill/East 101/Pacheco Pass Alignment:** This alignment would extend south along the Caltrain/UPRR rail corridor transitioning to south U.S. 101 east through the Pacheco Pass and the San Joaquin Valley to Merced.

The Caltrain/Morgan Hill/East 101/Pacheco Pass Alignment option is similar to the Caltrain/Morgan Hill/Pacheco Pass option, with the exception that utilizes the U.S. 101 corridor to connect to the Caltrain corridor north of Morgan Hill as opposed to south of Morgan Hill. Travel times would be slightly improved with this option, but there would be a reduction in compatibility with development and this option would provide less accessibility than the Caltrain/Morgan Hill/Pacheco Pass alternative. This option would not provide a direct link to the Caltrain commuter rail service south of San Jose. The Caltrain/Morgan Hill/East of 101/Pacheco Pass option would be entirely constructed on aerial structure and in tunnel configuration. Therefore, the cost of this option is expected to be slightly higher than the Caltrain/Morgan Hill/Pacheco Pass option that includes grade separation improvements to adjacent freight and commuter tracks. This alignment would pass through the highest length of floodplain of all the Pacheco Pass options.

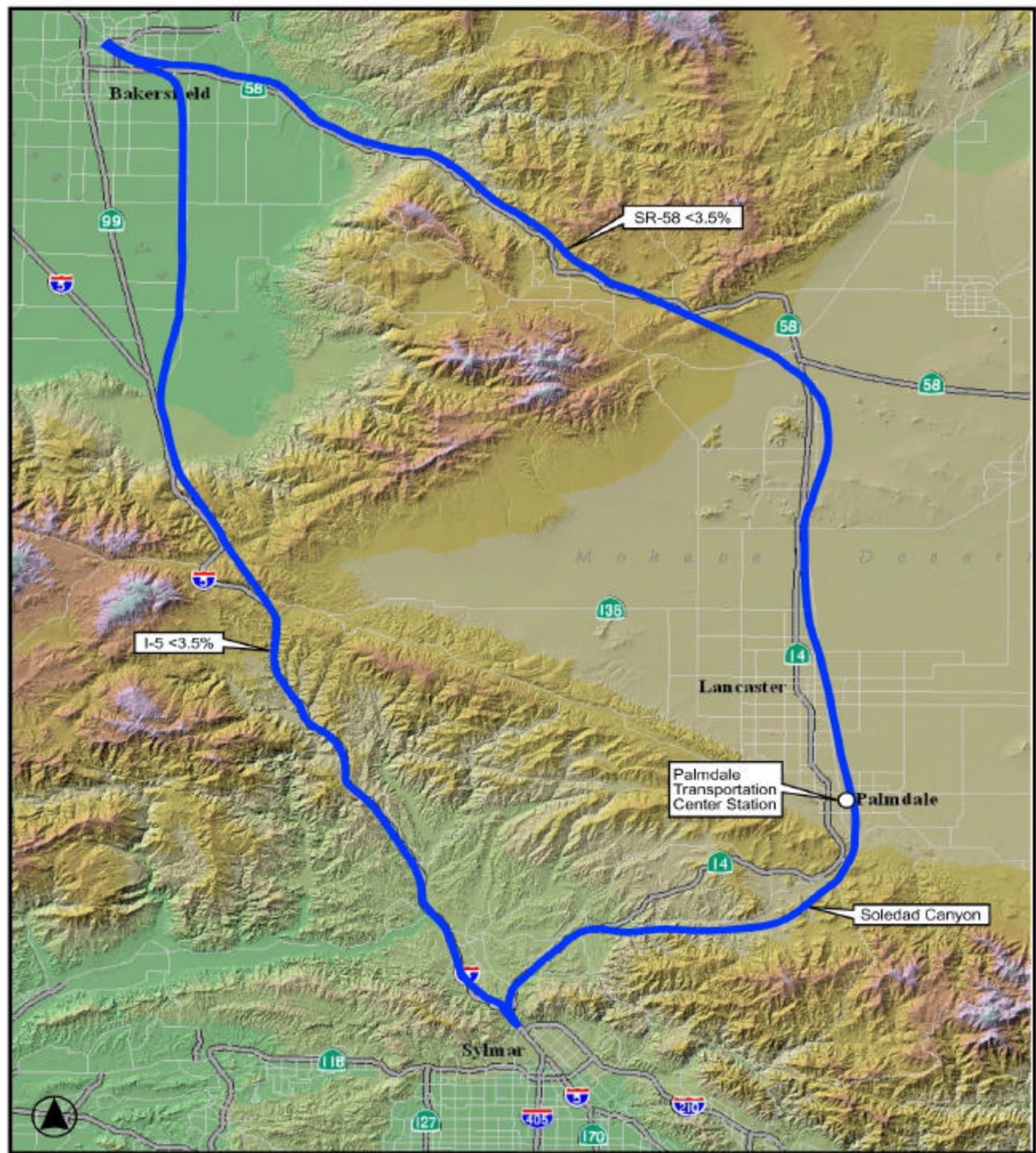
Station Locations:

- **Morgan Hill (Foothills) Station:** This potential station site would only serve the Pacheco Pass/Foothills/Morgan Hill/Caltrain alternative that staff recommends be eliminated from further investigation.
- **Morgan Hill (E. of 101) Station:** This potential station would only serve the Pacheco Pass/East of 101/Caltrain alternative that staff recommends be eliminated from further investigation.

Bakersfield-to-Sylmar

Alignment and Station Location Options for Further Evaluation

Based on information obtained through the initial evaluation, the following alignment and station location is recommended for further evaluation (see Figure 3)



Legend

- Alignments to be Evaluated
- Station Locations to be Evaluated

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Alignments and Station Locations to be Evaluated Bakersfield-to-Sylmar Segment

Figure 3

Alignments:

- **I-5 (3.5% maximum grade):** This alignment extends east along the Union Pacific Railroad (UPRR) from a Bakersfield station, south along State Route 184 (SR-184)/Wheeler Ridge Road, and generally follows I-5 over the Tehachapi Mountains through Santa Clarita to Sylmar.

The I-5 alignment has the most direct route from Bakersfield to Sylmar offering the best travel time for intercity trips with the highest ridership potential. Based on the information derived from the tunneling workshop as well as the alignment optimization from Quantm a portion of the original alignment was diverted slightly to the east to facilitate the crossing of both major fault zones (San Andreas and Garlock) at-grade with a total of 18 miles of tunneling with a maximum tunnel length of 6 miles. Further environmental analysis will need to be conducted on this I5 variation to assess its viability. There is concern that the Garlock Fault crossing in the floodplain west of Castac Lake will create significant biological impacts. This area needs to be surveyed.

The Quantm system also identified a western variation of the original I5 alignment, which crosses one major fault (San Andreas) in a tunnel. If the eastern alignment were to be determined infeasible the western alignment as well as the original alignment should be investigated further. The minor eastern and western divergences of the original alignment would not impact the operations or travel times of the I-5 alignment.

- **SR-58/Soledad Canyon (3.5% maximum grade):** This alignment extends from Bakersfield along State Route 58 (SR-58) east from Bakersfield, generally following SR-58 through the Tehachapis to Mojave, along Metrolink/UPRR through Antelope Valley and Soledad Canyon and generally following State Route 14 (SR-14) from Santa Clarita to Sylmar.

The SR-58/Soledad Canyon alternative at 3.5% maximum grade minimizes the tunneling (10.1 miles of total tunneling) and capital costs and allows the alignment to cross both the San Andreas and Garlock Faults at grade. This alignment generally follows existing highway and/or railroad rights-of-way, presenting fewer concerns with respect to development and adjacent land use, and offering the best construction access. This alignment has very low potential to impact cultural resources and has the potential to serve the growing communities of the Antelope Valley. The Quantm system produced a variation of the Soledad Canyon alignment that maybe considered in order to reduce impacting potentially sensitive ecological areas.

Station Locations:

- **Antelope Valley (Palmdale Transportation Center):** This potential station would serve SR-58/Soledad Canyon alignment, maximizing the connectivity and accessibility while minimizing the impacts to social and economic and cultural resources.

2.1.2 Alignment and Station Location Options to be Eliminated (No Further Evaluation)

Based on information obtained through the initial evaluation, the following alignment and station location options are those recommended to be eliminated from further evaluation (see Figure 4):

Alignments:

- **I-5 (2.5% grade):** This alignment extends east along the Union Pacific Railroad (UPRR) from a Bakersfield station, south along State Route 184 (SR-184)/Wheeler Ridge Road, and generally follows I-5 over the Tehachapi Mountains through Santa Clarita to Sylmar.

The I-5 at 2.5% grade alignment alternative has extensive tunneling, the highest capital costs of the I-5 alignments. This option does not allow the alignment to cross the San Andreas and the Garlock faults at-grade and would require a maximum single tunnel length of more than 33 miles.

- **I-5 via Comanche Point:** This alignment extends east along the Union Pacific Railroad (UPRR) from a Bakersfield station, south along State Route 184 (SR-184), then south-southeast to Comanche Point along an existing power easement, tunneling from Comanche Point and converging back with the I-5 alignment.

The I-5 via Comanche Point alignment crosses through a region of highly sheared and distorted rock between the San Andreas Fault and the Garlock Fault, crossing both faults in a deep tunnel. This alignment closely follows the existing California Aqueduct tunnel alignment through the Tehachapi Mountains, based on the experience in constructing that facility, tunneling through fractured rock would require slow drill-and-blast methods for long segments of the alignment. Because the area between the faults is highly sheared and unstable, an enlarged fault chamber could be required for the entire reach between the two faults. Additionally, within these limits, high volumes of groundwater would also likely be encountered in fractured rock.

- **SR-58/SR-14 (2.5% and 3.5% grade):** This alignment extends from Bakersfield along State Route 58 (SR-58) east from Bakersfield, generally following SR-58 through the Tehachapis to Mojave, along Metrolink/UPRR through Antelope Valley, diverging from Metrolink/UPRR south of Palmdale generally following SR-14 to Sylmar.

The SR-58/SR-14 at 2.5% grade alignment alternative has extensive tunneling, the highest capital costs, and does not allow the alignment to cross both the San Andreas and the Garlock faults at-grade. The SR-14 portion of the SR-58/SR-14 alignment passes through heavily developed and currently developing areas with the potential of constraining the expansion of the SR-14, which is currently the only direct route from the Antelope Valley to Santa Clarita and the Los Angeles basin. This alignment requires multiple crossings of the SR-14 freeway and the Santa Clara River creating significant visual impacts and adding to the cost of construction.

- **SR-58/Soledad Canyon (2.5% grade):** This alignment extends from Bakersfield along State Route 58 (SR-58) east from Bakersfield, generally following SR-58 through the Tehachapis to Mojave, along Metrolink/UPRR through Antelope Valley and Soledad Canyon and generally following State Route 14 (SR-14) from Santa Clarita to Sylmar.

The SR-58/Soledad Canyon at 2.5% grade alignment alternative has extensive tunneling, the highest capital costs, and does not allow the alignment to cross both the San Andreas and the Garlock faults at-grade. This alternative would require 20 to 30 miles more tunneling than the SR-58/Soledad Canyon alternative at 3.5% grade.

- **SR-138/Soledad Canyon:** This alignment variation of the California Aqueduct corridor extends east along the UPRR from a Bakersfield station, south along SR-184, then south-southeast to Comanche Point along an existing power easement, tunneling under the Tehachapi mountains near the California Aqueduct, then veering to the east along SR-138 to the Metrolink/UPRR, through Soledad Canyon and generally following SR-14 from Santa Clarita to Sylmar.
- **SR-138/SR-14:** This alignment diverges from the Metrolink/UPRR, generally following SR-14 to Sylmar.

The SR-138/Soledad Canyon and SR-138/SR-14 alignments require deep tunneling through the Garlock Fault zone. As a result, the SR-138 alignment presents significantly higher construction costs and risks

than the SR-58. The SR-58 alternative at a maximum 3.5% grade would allow for at-grade fault crossings for both major faults, shorter tunnels and significantly less tunneling, while providing the same service to Antelope Valley and virtually identical travel times from Bakersfield to Sylmar.

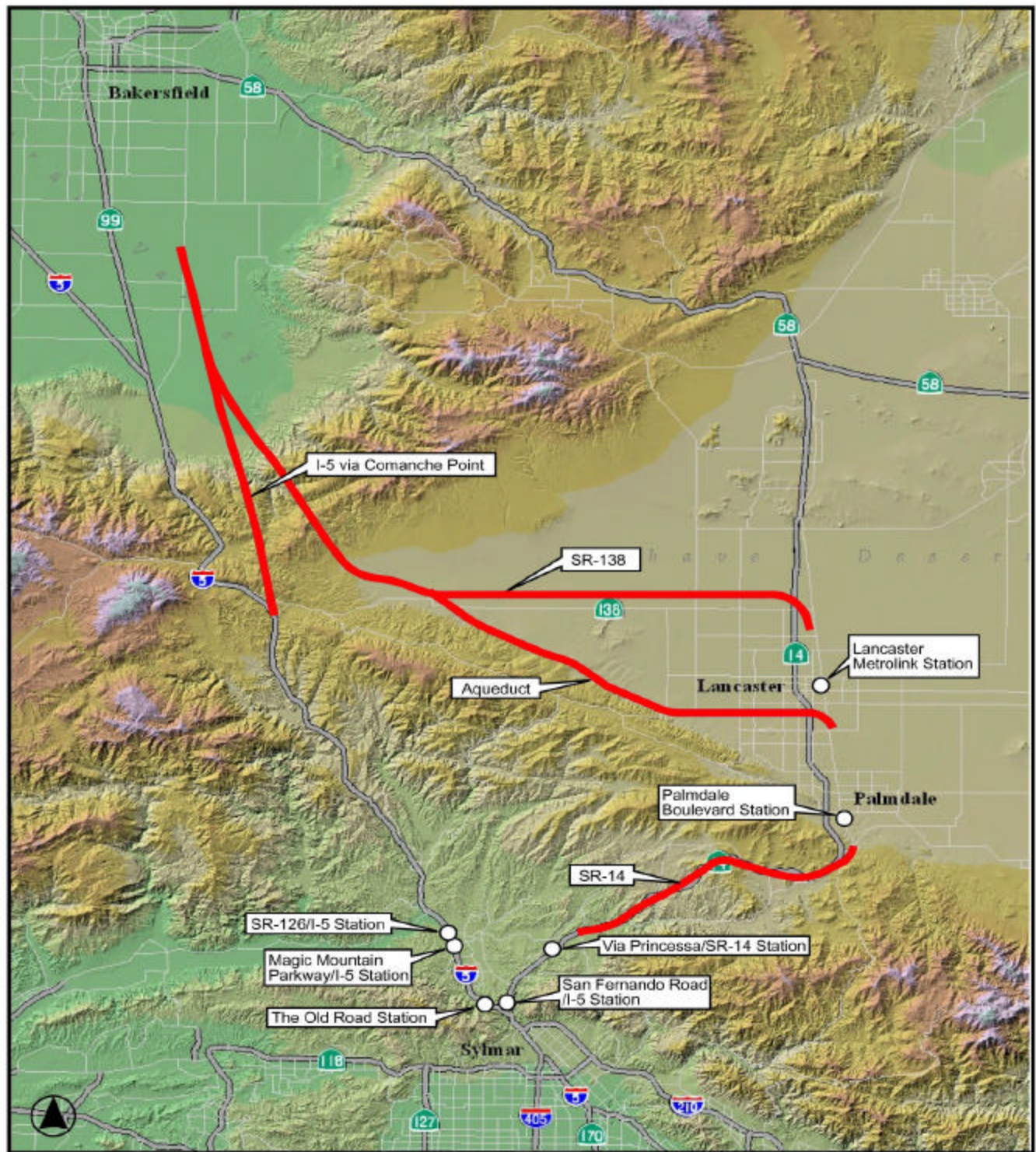
- **Aqueduct/Soledad Canyon:** This alignment extends east along the UPRR from a Bakersfield station, south along SR-184, then south-southeast to Comanche Point along an existing power easement, tunneling under the Tehachapi mountains near the California Aqueduct, generally following the Aqueduct to SR-14, through Soledad Canyon, and then generally following SR-14 from Santa Clarita to Sylmar.
- **Aqueduct/SR-14:** This variation of the Aqueduct corridor follows the same alignment as the Aqueduct/Soledad Canyon the exception is that this alignment generally follows SR-14 through the Antelope Valley to Sylmar.

These variations of the Aqueduct corridor closely parallel the San Andreas Fault for a long distance, creating a long segment subject to high seismic shaking and potential ground movement. Additionally these variations would have more environmental impacts, have a higher capital cost, and are less compatible with existing and planned development.

Station Locations:

- **Santa Clarita (SR-126/I-5):** This station site lies immediately east of the SR-126/I-5 interchange in close proximity to the freeway-to-freeway interchange bridges and ramps which would require either an aerial or tunnel approach to the station site. A tunnel approach would require a widened tunnel with special ventilation and life safety systems and would present significant construction challenges. An overhead approach would require a structure that spans the existing interchange bridges and can accommodate the necessary crossovers and station tracks. Deep cuts/fills, drainage requirements, retaining walls and highway access requirements would also result in substantially higher station construction costs. This station site is located in an area affected, in part, by flooding from the Santa Clara River and is adjacent to an existing oil field that is designated as Mineral/Oil Conservation Area Open Space.
- **Santa Clarita (Magic Mountain Parkway):** This station site lies immediately north of a potential tunnel on the I-5 alignment. The proximity of the station platforms to the tunnel portal would have negative implications on the required configuration of the tunnel and the northerly tunnel portal. The station site would necessitate a widened tunnel cross-section to accommodate the crossovers and switching tracks to serve the platform tracks from the mainline tracks. This tunneling widening would require special ventilation and life safety considerations and would present significant construction challenges. The site is highly constrained by adjacent development and an existing oil field and there are several hazardous waste sites near the station location.
- **Santa Clarita (Via Princessa/SR-14):** This station site requires the widening of a tunnel at its north-easterly end to accommodate crossovers and switching tracks as well as a portion of the platform length. This configuration would require special ventilation and life safety considerations and would present significant construction challenges and high construction costs. In addition, this station location is in a high growth area that is currently being developed with commercial and residential uses. Significant new and planned development would be displaced by station facilities. The site is located on land designated for Residential Moderate and Community Commercial land uses in the County of Los Angeles General Plan and would be close to a planned school. There is no proposed or existing intermodal connection near this proposed station site. Via Princessa, a Major Highway planned for a minimum of 6 lanes, would have to be extended to accommodate access to this station site.

- **Santa Clarita (The Old Road):** This potential station site has no existing road access and is being considered for environmental conservation, thus resulting in higher environmental impacts and incompatibility with existing or planned development.
- **Santa Clarita (San Fernando Road/SR-14):** This potential station site has no existing road access and is within a National Forest, thus resulting in higher environmental impacts and incompatibility with existing or planned development.
- **Antelope Valley (Lancaster Metrolink Station):** This station site would be an aerial structure and therefore more costly to build than the Palmdale Transportation Center Station. It would also require modification to the existing Metrolink facility. Commercial and light industrial land uses adjacent to the track may be affected or displaced by station facilities. Sierra Highway and Lancaster Boulevard may need to be widened to accommodate traffic caused by the station. The proposed Palmdale Transportation Center would provide better connectivity due to its proximity to the Palmdale Airport, local and regional bus service and a planned Metrolink stop.



Legend

- Alignments to be Eliminated
- Station Locations to be Eliminated

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Alignments and Station Locations to be Eliminated Bakersfield-to-Sylmar Segment

Figure 4